**DESCRIPTION**

Microsemi offers a series of PIN diodes specifically designed and characterized for solid state antenna switches in commercial two-way radios. Antenna switches using the UM9401 and UM9415 series PIN diodes provide high isolation, low loss and low distortion characteristics formerly possible only with electromechanical relay type switches.

The UM9401 and the UM9402 diodes can handle 100 W of transmitter power, while the UM9415 will handle over 1000 W. The extensive characterization of these PIN diodes in antenna switch applications has resulted in guaranteed low distortion specifications under transmit and receive conditions. These diodes also feature low forward bias resistance and high zero bias impedance which are required for low loss, high isolation and wide bandwidth antenna switch performance. For RoHS compliant devices, use the UMX prefix. (IE: UMX9415)

The UMX series meets RoHS requirements per EU Directive 2002/95/EC.

**IMPORTANT:** For the most current data, consult our website: [www.MICROSEMI.com](http://www.MICROSEMI.com)

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**ABSOLUTE MAXIMUM RATINGS AT 25º C (UNLESS OTHERWISE SPECIFIED)**

<table>
<thead>
<tr>
<th>CONDITION</th>
<th>UM9401</th>
<th>UM9402</th>
<th>UM9415</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reverse Voltage (VR) @ IR = 10 μA</td>
<td>50V</td>
<td>50V</td>
<td>50V</td>
</tr>
<tr>
<td>Average Power Dissipation (PA)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>½ in. total length to 25 ºC Contact</td>
<td>5.5W</td>
<td>10W</td>
<td></td>
</tr>
<tr>
<td>25 ºC (Package Flange Temperature)</td>
<td>10W</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Free Air</td>
<td>1.5W</td>
<td>2.5W</td>
<td></td>
</tr>
<tr>
<td>Operating Temp. (TOP)</td>
<td>-65 ºC to +175 ºC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage Temp. (TSTG)</td>
<td>-65 ºC to +175 ºC</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**KEY FEATURES**

- High transmitter power
  - UM9401/UM9402 => 100 W
  - UM9415 => 1000 W
- Low harmonic distortion
- Low third order distortion
- High carrier lifetime
- Non cavity design
- Thermally matched configuration
- Low capacitance at 0 V bias
- Low conductance at 0 V bias
- Compatible with automatic insertion equipment
- RoHS complaint versions available.

RoHS compliant versions of the UM9401 and UM9415 are supplied as UMX9401, UMX9415. Consult factory for details.

**APPLICATIONS/BENEFITS**

- Isolated stud package available
- Surface mount package available
- Maximum soldering temperature 260 ºC for 30 seconds.
# COMMERCIAL TWO WAY RADIO ANTENNA SWITCH DIODES

RoHS Compliant Versions Available

## ELECTRICAL PARAMETERS @ 25°C (unless otherwise specified)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>UM9401 / UM9402</th>
<th>UM9415</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reverse Current</td>
<td>$I_R$</td>
<td>$V_R = 50$ V</td>
<td>10</td>
<td>10 uA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Series Resistance</td>
<td>$R_S$</td>
<td>$I_F = 50$ mA, $F= 100$ MHz</td>
<td>0.75</td>
<td>1.0</td>
<td>0.75</td>
<td>1.0</td>
<td>Ω</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capacitance</td>
<td>$C_T$</td>
<td>$V_R = 0$ V, $F = 100$ MHz</td>
<td>1.1</td>
<td>1.5</td>
<td>2.8</td>
<td>4</td>
<td>pF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parallel Resistance</td>
<td>$R_P$</td>
<td>$V_R = 0$ V, $F = 100$ MHz</td>
<td>5</td>
<td>10</td>
<td>1</td>
<td>2</td>
<td>kΩ</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carrier Lifetime</td>
<td>$T_L$</td>
<td>$I_F = 10$ mA</td>
<td>1.0</td>
<td>2.0</td>
<td>5.0</td>
<td></td>
<td>us</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forward Voltage</td>
<td>$V_F$</td>
<td>$I_F = 50$ mA</td>
<td>1.0</td>
<td>1.0</td>
<td>V</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transmit Harmonic Distortion</td>
<td>$R_{2A}/A$</td>
<td>$P_{in} = 50$ W, $f = 50$ MHz, $I_F = 50$ mA</td>
<td>80</td>
<td></td>
<td>80</td>
<td>-dB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$R_{3A}/A$</td>
<td>$P_{in} = 50$ W, $f = 50$ MHz, $I_F = 50$ mA</td>
<td>80</td>
<td></td>
<td>80</td>
<td>-dB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Receive Third Order Distortion</td>
<td>$R_{2AB}/A$</td>
<td>$P_{in} = 10$ W, $0$ V Bias, $f_A = 50$ MHz, $f_B = 51$ MHz</td>
<td>60</td>
<td></td>
<td>60</td>
<td>-dB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
COMMERCIAL TWO WAY RADIO ANTENNA SWITCH DIODES

RoHS Compliant Versions Available

RS VS IF

VF VS IF

CT VS FREQUENCY

RP VS FREQUENCY

Vf versus If
TYPICAL

If (A)

Vf (V)

Rs (Ohms)

If versus Rs
TYPICAL

Rs versus If
TYPICAL

f = 100 MHz

Vf versus If
TYPICAL

If (A)

Vf (V)

Ct (pF)

Ct versus f
TYPICAL

f (MHz)

Rp (kOhms)

Rp versus f
TYPICAL

f (MHz)
COMMERCIAL TWO WAY RADIO ANTENNA SWITCH DIODES

RoHS Compliant Versions Available

UM9401 / UM9402 / UM9415

UM9415 POWER CURVE

UM9401, 9402 POWER CURVE

UM9415 MAX POWER

UM9401, 9402 MAX POWER

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Microwave Products
75 Technology Drive, Lowell, MA. 01851, 978-442-5600, Fax: 978-937-3748
COMMERCIAL TWO WAY RADIO
ANTENNA SWITCH DIODES

RoHS Compliant Versions Available

“STYLE” UM9401B

“STYLE” UM9415B

“STYLE” UM9401SM

“STYLE” UM9415SM

CATHODE BAND

CATHODE BAND

CATHODE BAND

CATHODE BAND

.031/0.029 DIA

.090 DIA MAX

0.055 DIA MAX

.041/0.039 DIA

.145 DIA MAX

.092 DIA MAX

.168/0.200

.019/0.028

.001 MIN

.200/0.225

.137/0.148

.019/0.028

.001 MIN
COMMERCIAL TWO WAY RADIO
ANTENNA SWITCH DIODES

RoHS Compliant Versions Available

“STYLE” UM9402

UM9401SM FOOTPRINT

UM9415SM FOOTPRINT

B SIZE
(STANDARD LARGE SQUARE END CAP OUTLINE)

A SIZE
(STANDARD SMALL SQUARE END CAP OUTLINE)

NOTES:
1. THESE DIMENSIONS WILL MATCH THE TERMINALS AND PROVIDE FOR ADDITIONAL SOLDER PILLS AT THE OUTBOARD ENDS AT LEAST AS VIDE AS THE TERMINALS THEMSELVES, ASSURING ACCURACY OF DEVICE PLACEMENT WITHIN ±0.007.
2. IF THE MOUNTING METHOD CHOSEN REQUIRES USE OF AN ADHESIVE SEPARATE FROM THE SOLDER COMPOUND, A ROUND OR SQUARE SPOT OF ADHESIVE AS SHOWN SHOULD BE CENTRALLY LOCATED.

UM9401 / UM9402 / UM9415

Microsemi
Microwave Products
75 Technology Drive, Lowell, MA, 01851, 978-442-5600, Fax: 978-937-3748
Maximum Transmitter Power

The maximum CW transmitter power, $P_{T(\text{max})}$, a PIN diode antenna switch can handle depends on the diode resistance, $R_s$, power dissipation, $P_D$, antennae SWR, $\sigma$, and the nominal impedance, $Z_0$. The expression is as follows:

$$P_{T(\text{max})} = \frac{P_D x Z_0}{R_s} \left( \frac{\sigma + 1}{\sigma} \right)^2 \text{[Watts]}$$

Characteristic curves are shown in the data section which gives both the maximum and typical diode resistance, $R_s$ as a function of forward current. The maximum power dissipation rating of the PIN diode depends both on the length of the diode leads and the temperature of the contacts to which the leads are connected. A graph defining the maximum power dissipation at various combinations of overall lead length ($L$) and lead temperature ($T_L$) is given in the data section. From these curves and the above equation, the power handling capability of the PIN diode may be computed for a specific application.

Curves are also presented which show the maximum transmitter power that an antenna switch using UM9401s and UM9415s can safely handle for various forward currents and lead temperatures. These curves are based on a typical design condition of a \( \frac{1}{2} \) in. total overall lead length, 50 $\Omega$ line impedance, and a totally mismatched antenna ($\sigma = \infty$). For the case of a perfectly matched antenna, the maximum transmitter power can be increased by a factor of 4.

Design Information

A circuit configuration for a two-way radio antenna switch using PIN diodes consists of a diode placed in series with the transmitter and a shunt diode placed a quarter wavelength from the antenna in the direction of the receiver as shown. For low frequency operation, the quarter wave line may be simulated by lumped elements. Typical performance of antenna switches using PIN diodes forward biased at 100 mA is less than 0.2 dB insertion loss and 30 dB isolation during transmit; at zero bias the receive insertion loss is less than 0.3 dB. This performance is achievable across a ±20% bandwidth at center frequencies ranging from 10 to 500 MHz.